

Lecture Notes in Electrical Engineering 964

Sarika Jain

Sven Groppe

Bharat K. Bhargava *Editors*

Semantic Intelligence

Select Proceedings of ISIC 2022



Springer

Lecture Notes in Electrical Engineering

Volume 964

Series Editors

Leopoldo Angrisani, Department of Electrical and Information Technologies Engineering, University of Napoli Federico II, Naples, Italy
Marco Arteaga, Departament de Control y Robótica, Universidad Nacional Autónoma de México, Coyoacán, Mexico
Bijaya Ketan Panigrahi, Electrical Engineering, Indian Institute of Technology Delhi, New Delhi, Delhi, India
Samarjit Chakraborty, Fakultät für Elektrotechnik und Informationstechnik, TU München, Munich, Germany
Jiming Chen, Zhejiang University, Hangzhou, Zhejiang, China
Shanben Chen, Materials Science and Engineering, Shanghai Jiao Tong University, Shanghai, China
Tan Kay Chen, Department of Electrical and Computer Engineering, National University of Singapore, Singapore, Singapore
Rüdiger Dillmann, Humanoids and Intelligent Systems Laboratory, Karlsruhe Institute for Technology, Karlsruhe, Germany
Haibin Duan, Beijing University of Aeronautics and Astronautics, Beijing, China
Gianluigi Ferrari, Università di Parma, Parma, Italy
Manuel Ferre, Centre for Automation and Robotics CAR (UPM-CSIC), Universidad Politécnica de Madrid, Madrid, Spain
Sandra Hirche, Department of Electrical Engineering and Information Science, Technische Universität München, Munich, Germany
Faryar Jabbari, Department of Mechanical and Aerospace Engineering, University of California, Irvine, CA, USA
Limin Jia, State Key Laboratory of Rail Traffic Control and Safety, Beijing Jiaotong University, Beijing, China
Janusz Kacprzyk, Systems Research Institute, Polish Academy of Sciences, Warsaw, Poland
Alaa Khamis, German University in Egypt El Tagamoa El Khames, New Cairo City, Egypt
Torsten Kroeger, Stanford University, Stanford, CA, USA
Yong Li, Hunan University, Changsha, Hunan, China
Qilian Liang, Department of Electrical Engineering, University of Texas at Arlington, Arlington, TX, USA
Ferran Martín, Departament d'Enginyeria Electrònica, Universitat Autònoma de Barcelona, Bellaterra, Barcelona, Spain
Tan Cher Ming, College of Engineering, Nanyang Technological University, Singapore, Singapore
Wolfgang Minker, Institute of Information Technology, University of Ulm, Ulm, Germany
Pradeep Misra, Department of Electrical Engineering, Wright State University, Dayton, OH, USA
Sebastian Möller, Quality and Usability Laboratory, TU Berlin, Berlin, Germany
Subhas Mukhopadhyay, School of Engineering and Advanced Technology, Massey University, Palmerston North, Manawatu-Wanganui, New Zealand
Cun-Zheng Ning, Electrical Engineering, Arizona State University, Tempe, AZ, USA
Toyooki Nishida, Graduate School of Informatics, Kyoto University, Kyoto, Japan
Luca Oneto, Department of Informatics, BioEngineering, Robotics and Systems Engineering, University of Genova, Genova, Genova, Italy
Federica Pascucci, Dipartimento di Ingegneria, Università degli Studi "Roma Tre", Rome, Italy
Yong Qin, State Key Laboratory of Rail Traffic Control and Safety, Beijing Jiaotong University, Beijing, China
Gan Woon Seng, School of Electrical and Electronic Engineering, Nanyang Technological University, Singapore, Singapore
Joachim Speidel, Institute of Telecommunications, Universität Stuttgart, Stuttgart, Germany
Germano Veiga, Campus da FEUP, INESC Porto, Porto, Portugal
Haitao Wu, Academy of Opto-electronics, Chinese Academy of Sciences, Beijing, China
Walter Zamboni, DIEM—Università degli studi di Salerno, Fisciano, Salerno, Italy
Junjie James Zhang, Charlotte, NC, USA

The book series *Lecture Notes in Electrical Engineering* (LNEE) publishes the latest developments in Electrical Engineering—quickly, informally and in high quality. While original research reported in proceedings and monographs has traditionally formed the core of LNEE, we also encourage authors to submit books devoted to supporting student education and professional training in the various fields and applications areas of electrical engineering. The series cover classical and emerging topics concerning:

- Communication Engineering, Information Theory and Networks
- Electronics Engineering and Microelectronics
- Signal, Image and Speech Processing
- Wireless and Mobile Communication
- Circuits and Systems
- Energy Systems, Power Electronics and Electrical Machines
- Electro-optical Engineering
- Instrumentation Engineering
- Avionics Engineering
- Control Systems
- Internet-of-Things and Cybersecurity
- Biomedical Devices, MEMS and NEMS

For general information about this book series, comments or suggestions, please contact leontina.dicecco@springer.com.

To submit a proposal or request further information, please contact the Publishing Editor in your country:

China

Jasmine Dou, Editor (jasmine.dou@springer.com)

India, Japan, Rest of Asia

Swati Meherishi, Editorial Director (Swati.Meherishi@springer.com)

Southeast Asia, Australia, New Zealand

Ramesh Nath Premnath, Editor (ramesh.premnath@springernature.com)

USA, Canada

Michael Luby, Senior Editor (michael.luby@springer.com)

All other Countries

Leontina Di Cecco, Senior Editor (leontina.dicecco@springer.com)

**** This series is indexed by EI Compendex and Scopus databases. ****

Sarika Jain · Sven Groppe · Bharat K. Bhargava
Editors

Semantic Intelligence

Select Proceedings of ISIC 2022

 Springer

Editors

Sarika Jain
Department of Computer Applications
National Institute of Technology
Kurukshetra, India

Sven Groppe
Department of Computer Science
University of Lübeck
Lübeck, Germany

Bharat K. Bhargava
Department of Computer Sciences
Purdue University West Lafayette
West Lafayette, IN, USA

ISSN 1876-1100

ISSN 1876-1119 (electronic)

Lecture Notes in Electrical Engineering

ISBN 978-981-19-7125-9

ISBN 978-981-19-7126-6 (eBook)

<https://doi.org/10.1007/978-981-19-7126-6>

© The Editor(s) (if applicable) and The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023, corrected publication 2023

This work is subject to copyright. All rights are solely and exclusively licensed by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors, and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Singapore Pte Ltd.

The registered company address is: 152 Beach Road, #21-01/04 Gateway East, Singapore 189721, Singapore

Organization

Advisory Committee



Rajkumar Buyya
CLOUDS Lab, School of Computing and Information Systems,
The University of Melbourne, Australia
rbuyya@unimelb.edu.au



Gurdeep Singh Hura
University of Maryland Eastern Shore, USA
gshura@umes.edu



Valentina Emilia Balas
Aurel Vlaicu University of Arad, Romania
balas@drbalas.ro

(continued)

(continued)



Bharat K. Bhargava
Purdue University, Indiana, United States
bbshail@purdue.edu

General Chairs



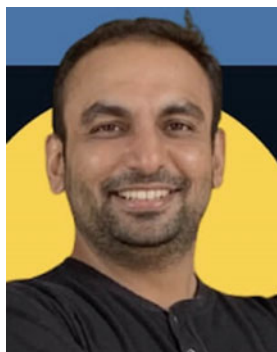
Sarika Jain
National Institute of Technology, Kurukshetra, Haryana, India
jasarika@nitkr.ac.in
<https://sites.google.com/view/nitkkrsarikajain>



Sven Groppe
University of Lübeck, Germany
groppe@ifis.uni-luebeck.de
<http://www.ifis.uni-luebeck.de/~groppe/>

Track PC Chairs

Valentina Janev
The Mihajlo Pupin Institute, Belgrade, Serbia
Valentina.Janev@instituteupin.com



Manas Gaur
Artificial Intelligence Institute, University of South Carolina,
Columbia, United States
MGAUR@email.sc.edu
<https://manasgaur.github.io/>



Asha Subramanian
Founder and CEO, Semantic Web India, Bengaluru, India
asha@semanticwebindia.com
<https://www.semanticwebindia.com/Aboutus.html>

Organizing Chairs

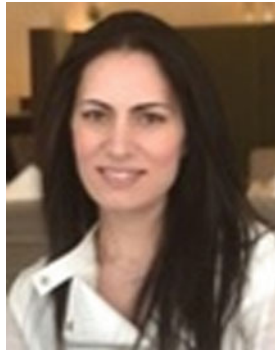


Atef Mohamed (Shalan)
Allen E. Paulson College of Engineering and Computing,
Georgia Southern University, United States
amohamed@georgiasouthern.edu



Hossain Shahriar
Associate Professor, BSIT/BASIT Coordinator, College of
Computing and Software Engineering; Director of Research
and Graduate Education, Institute for Cybersecurity Workforce
Development, Marietta, GA 30060, United States
hshahria@kennesaw.edu
<https://msit.kennesaw.edu/current-students/faculty.php>

Workshops and Special Sessions Chairs



Pelin Angin
Middle East Technical University, Ankara, Turkey
pangin@ceng.metu.edu.tr
<https://user.ceng.metu.edu.tr/~pangin/>

(continued)

(continued)



Prateek Agrawal
Associate Professor, Lovely Professional University, India
prateek061186@gmail.com
<http://www.itec.aau.at/~prateek/>

Publication Chairs



Jyotir Moy Chatterjee
Assistant Professor (IT) Lord Buddha Education Foundation
(Asia Pacific University of Technology and Innovation),
Kathmandu, Nepal
jyotirchatterjee@gmail.com
<https://sites.google.com/view/jyotirmoychatterjee>



Sachi Nandan Mohanty
Department of Computer science & Engineering, ICFAITech,
ICFAI Foundation for Higher Education, Hyderabad, India
sachinandan09@gmail.com
<http://drsachinandan.com/>

Publicity Chairs



Md Rafiqul Islam
University of Technology Sydney, Australia
MdRafiqul.Islam@uts.edu.au
<https://rafiqulislamcse24.wixsite.com/rafiqulcse>

Website Chairs



Mohamed Hamada
Senior Associate Professor The University of Aizu, Japan
Hamada@u-aizu.ac.jp
<http://www.u-aizu.ac.jp/~hamada/>



Ahmed A. Elngar
Assistant Professor, Faculty of Computers & Artificial
Intelligence, Beni-Suef University, Egypt
eIngar_7@yahoo.co.uk
<https://bsu-eg.academia.edu/AhmedElngar>

Technical Program Committee

Kumar Abhishek, NIT Patna
 Moussa Aboubakar, LIST, Communicating Systems Laboratory, France
 Prateek Agrawal, University of Klagenfurt, Austria
 Nesar Ahmad, AMU, Aligarh
 Tameem Ahmad, Aligarh Muslim University, Aligarh
 Syed Ahmed, Aligarh Muslim University
 Pelin Angin, Middle East Technical University, Turkey
 Valentina Emilia Balas, Aurel Vlaicu University of Arad, Romania
 Shajulin Benedict, IIIT Kottayam, India
 Bharat K. Bhargava, Purdue University, United States
 Amit Bhatia, Senior Principal Research Scientist, BAE Systems Inc, FAST Labs, NC, USA
 Suparna Biswas, Maulana Abul Kalam Azad University of Technology, West Bengal, India
 Rajkumar Buyya, The University of Melbourne, Australia
 Joel Luís Carbonera, UFRGS (Federal University of Rio Grande do Sul), Brazil
 Jyotir Moy Chatterjee, Lord Buddha Education Foundation, Kathmandu, Nepal
 Pethuru Raj, Reliance Jio Infocomm Ltd., Tamil Nadu, India
 Chandreyee Chowdhury, Jadavpur University, India
 Neama Abdulaziz Dahan, Sana'a University, Yemen
 Olawande Daramola, Cape Peninsula University of Technology, South Africa
 Gerard Deepak, Sr. Research Scholar, NIT Tiruchirappalli, India
 Ajantha Devi, AP3 Solutions, Chennai, India
 Abderrahim El Qadi, Mohammed V University in Rabat Morocco
 Moawia Elfaki Yahia Eldow, University of Khartoum, Sudan
 Ahmed Elngar, Beni-Suef University, Egypt
 Nafees Farooqui, Dehradun Institute of Technology, Uttarakhand, India
 Xiao-Zhi Gao, University of Eastern Finland, Finland
 Shankey Garg, National Institute of Technology Raipur, India
 Vinay Gautam, Chitkara University, India
 Sachin Sharma, Manav Rachna International Institute of Research and Studies, Faridabad, India
 Hiranmay Ghosh, Ex-Advisor, TCS Research
 Prakash Gopalakrishnan, Amrita Vishwa Vidyapeetham
 Vikas Goyal, Education Department, Haryana, India
 Sven Groppe, University of Lubeck, Germany
 Le Gruenwald, The University of Oklahoma, USA
 Charu Gupta, Indraprastha University, India
 Kapil Gupta, NIT Kurukshetra
 Mohamed Hamada, Aizu University, Japan
 Xavierlal J Mattam, Sacred Heart College, Kerala, India
 Priti Jagwani, Ram Lal Anand College
 Amit Jain, Sir Padampat Singhania University, Udaipur, India

Sarika Jain, National Institute of Technology, Kurukshetra
 Valentina Janev, The Mihajlo Pupin Institute, Belgrade, Serbia
 Yiming Ji, Georgia Southern University, USA
 Filbert H. Juwono, Lecturer, Department of. Electrical and Computer Engineering,
 Curtin University Malaysia
 Arpan Kar, Indian Institute of Technology Delhi, India
 Subodh Kesharwani, IGNOU, Delhi, India
 Laszlo T. Koczy, Budapest University of Technology and Economics, Hungary
 Petr Kremen, Czech Technical University in Prague, Czechia
 Naresh Kumar, IIT Roorkee, India
 Kamlesh Kumari, UIET, Kurukshetra University, India
 Naziha Laaz, Université Ibn Tofail, Kenitra, Morocco
 Shilpa S. Laddha, Govt. College of Engg., Aurangabad, Maharashtra, India
 Vishal Lama, Amdocs, Pune, India
 Aadil Ahmad Lawaye, BGSB University, India
 Dac-Nhuong Le, Haiphong University, Haiphong, Vietnam
 Ravi Lourdusamy, Sacred Heart College (Autonomous), Tirupattur, Vellore, Tamil
 Nadu, India
 Yang Lu, University of Kent, UK
 M. Niranjanamurthy, M. S. Ramaiah Institute of Technology, Bengaluru
 Aaisha Makkar, Thapar University, India
 Sonika Malik, MSIT, New Delhi, India
 Monika Mangla, CSED, LTCoE, Navi Mumbai
 Ganapathy Mani, Purdue University, USA
 Nikolaos Mavridis, United Arab Emirates University, United Arab Emirates
 A. Medina-Santiago, National Institute of Astrophysics, Optics and Electronics,
 Mexico
 Nandana Mihindukulasoor, IBM Research AI, India
 Sanjay Misra, Covenant University, Ota, Nigeria
 Ruchi Mittal, Netaji Subhas Institute of Technology, India
 SachiNandan Mohanty, ICFAI Foundation for Higher Education, Hyderabad, India
 Michael Mrissa, University of Primorska, Slovenia
 San Murugesan, BRITE Professional Services, Sydney, Australia
 Gagandeep Singh Narula, Guru Gobind Singh Indraprastha University, India
 Shahrul Azman Noah, Universiti Kebangsaan Malaysia
 Kingsley A. Ogudo, University of Johannesburg, South Africa
 Shanmugaraja P, Sona College of Technology, Salem, Tamil Nadu, India
 Jyoti Pareek, Professor in Computer Science, Gujarat University, India
 Nenad Petrovic, University of Nis, Serbia
 Prajoy Podder, Bangladesh University of Engineering and Technology, Bangladesh
 Shivika Prasanna, University of Missouri—Columbia, USA
 Iurii Prokopchuk, National Academy of Sciences of Ukraine, Ukraine
 Dana Rad, Aurel Vlaicu University of Arad, Romania
 Suja Radha, VIT University
 Ripal D Ranpara, Atmiya University, India

Regina Reine, Curtin University, Malaysia
Aleksei Rozhnov, Institute of Control Sciences, Moscow, Russia
Shridevi. S, Vellore Institute of Technology, India
Ayodeji Salau, AfeBabalola University, Ado-Ekiti, Nigeria
Neetu Sardana, Jaypee Institute of Information Technology, Noida, India
Salma Sassi, University of Jendouba, Tunisia
Suneeta Satpathy, BPUT, India
Sharad Saxena, Thapar University, India
K Kalaiselvi, Vels Institute of Science, Technology & Advanced Studies, Chennai, India
Fatmana Senturk, Pamukkale University, Turkey
Hossain Shahriar, Kennesaw State University, Georgia, USA
Atef Shalan, Georgia Southern University, Georgia, USA
Sachin Gengaje, WIT, Solapur
Sudhir Kumar Sharma, IITM Janakpuri, GGSIPU Delhi, India
Cogan Shimizu, DAGSI Fellow and Instructor, Data Semantics Lab, Wright State University, USA
Zee Ang Sim, Curtin University, Malaysia
Pranav K. Singh, Department of CSE, CIT Kokrajhar, India
Sushil Kumar Singh, Seoul National University of Science and Technology, South Korea
Vikram Singh, NIT Kurukshetra, India
Karen Smiley, Senior Technology Development Manager, BAE Systems Inc, FAST Labs, USA
Konstantinos Sofianos, Ionian University, Corfu, Greece
Rituraj Soni, Engineering College Bikaner, India
Sandeep Sood, Central University of Himachal Pradesh, Shahpur, Himachal Pradesh, India
Srinath Srinivasa, Web Science Lab, IIIT-Bangalore, Bengaluru, India
Sweta Srivastava, Amity University-Noida, India
Jon Stammers, University of Sheffield, England, United Kingdom
Asha Subramanian, Semantic Web India Private Limited, Bengaluru, India
Muhammad Imran Tariq, Superior University, Lahore, Pakistan
Mohseena Thaseen, NES Science College, Maharashtra, India
Sree Ganesh Thottempudi, University of Heidelberg and BBAW, Germany
Sanju Tiwari, Universidad Autonoma de Tamaulipas, Mexico
Ted Tschang, Singapore Management University, Singapore
Olegs Verhodubs, Training Center SIA DRMC, Latvia
Pawan Kumar Verma, GLA University, India
Benjamin Warnke, University of Lubeck, Germany
Wong Wei Kitt, Curtin University, Malaysia
Kai Wussow, SAP SE, Germany
Asmita Yadav, Jaypee Institute of Information Technology, Noida, India
Chandra Shekhar Yadav, STQC, MeitY, India
Anatolij Zabrovski, University of Klagenfurt, Austria

Acknowledgments

No one can whistle a symphony. It takes a whole orchestra to play it.

—H. E. Luccock

ISIC 2022 is the result of a larger group of people working together. The entire organizing committee had been extremely helpful in ensuring the success of ISIC 2022. The editors express their gratitude to the organizing team, which includes the track chairs, session chairs, technical program committee members, external reviewers, and also the authors. We are grateful to the many volunteers who worked tirelessly to ensure the event's success.

About This Book

Many ideas grow better when transplanted into another mind than the one where they sprang up.

—*Oliver Wendell Holmes*

Considering this quote as the sole motto of the International Semantic Intelligence Conference, this book constitutes the proceedings of the 2nd International Semantic Intelligence Conference (ISIC 2022), held at Georgia Southern University (Armstrong Campus), Savannah, United States from May 17 to 19, 2022. The ISIC is an international symposium that convenes to publish cutting-edge research results in intelligent applications for the Artificial Intelligence, Machine Learning, and Semantic Web communities.

Semantic Intelligence is rising as an important suite of technologies as a way forward with Artificial General Intelligence. Although the first version of ISIC 2021 started in the general domain of Artificial Intelligence and Machine Learning, we hope and envision that with years ISIC will succeed as a more focused Semantic Intelligence Conference.

ISIC 2022 has four top-shot invited researchers as advisory. The conference committee has diligently finalized the five keynote speakers. They are multi-diversified in nature across the whole world and are esteemed experts in their field. The main conference organization has 18 chair members whereas there are approximately 121 technical program committee members from various countries globally. ISIC 2022 also exhibits four pre-conference tutorials this year. The second edition of the conference also depicts a high geographical diversity from around 40 different countries as the members and more than 35% women as high gender diversity within its organization, similar to the last edition.

ISIC 2022 has been conducted in Online mode. Only high-quality manuscripts in the area of the conference are accepted for final publication by virtue of review and selection process. Every manuscript was reviewed by three to four reviewers and just like last year, this year also the acceptance rate was 50%. The volume comprises 22 manuscripts from 74 authors coming from 34 different universities/institutions over

10 different countries, namely, the United States, India, Germany, Serbia, Turkey, Nigeria, Italy, South Korea, Canada, and Morocco.

We invite proposals from universities and institutes to host the next edition of the International Semantic Intelligence Conference ISIC 2023.

Keynote Talks

ISIC 2022 witnessed five keynote talks in five different topics under the umbrella of Semantic Intelligence.

a. **Title:** Applying Knowledge Graphs for Data Analytics and Machine Learning

Speaker: Dr. Ernesto Jiménez-Ruiz (Lecturer, City, University of London)

Abstract: The application of knowledge graphs (KG) is going beyond the original vision of the Semantic Web and KGs are starting to play a key role to organize the enterprise, GLAM, and governmental data, and they are already the backbone in several bio-medical applications. Enterprises are also leveraging knowledge graphs to drive their products and make them more “intelligent.” The next steps in AI involve the creation of richer and smarter AI systems in regards to semantically sound, explainable, and reliable. Hybrid learning and reasoning systems combining subsymbolic and symbolic representations are gaining renewed attention, within both the Machine Learning (ML) and Knowledge Representation communities, to lead to the design and creation of such richer AI systems.

Video Link: <https://youtu.be/KSAKSOvCMHs>

Short Biography: Ernesto Jimenez Ruiz is a Lecturer in Artificial Intelligence at City, University of London affiliated to the Research Centers for Machine Learning and Artificial Intelligence. He is also a researcher in the Centre for Scalable Data Access (SIRIUS) at the University of Oslo, Norway. He previously held a Senior Research Associate position at The Alan Turing Institute in London (UK) and a Research Assistant position at the University of Oxford. His home university (Universitat Jaume I, Castellon, Spain) awarded a “Premio extraordinario de doctorado” (roughly translated as a Extraordinary Doctoral Award) to his doctoral thesis (Engineering category 2010–2011). His research has covered several areas, including bio-medical information processing and integration, ontology reuse, ontology versioning and evolution, ontology alignment. His current research interests focus on the application of Semantic Technology to Data Science workflows and the combination of Knowledge

Representation and Machine Learning techniques. My complete list of publications can be found here. The PDF of most of the articles are available online.

b. **Title:** Detect, Characterize, and Accommodate Novelities in AI systems.

Speaker: Bharat K. Bhargava (Purdue University, Indiana, USA)

Abstract: Novelities are surprises that an AI system encounters. It is easier for a human to detect novelties and adjust. An automated and autonomous system must learn about the characteristics and detect, understand, and adapt to novelty in not only the environment but in agents that interact with it. For example, in a game such as monopoly or chess, the rules of the game can be suddenly changed or players may change their objectives. Players may also collude with other players to achieve an outcome such as draw or extend the game beyond time limit, or make one of the players lose or win. Even though the military is trained to deal with different environments before deployments, it can encounter novelties that it must deal with. Example could be an enemy using a motorcycle on a narrow path in high mountains where jeep or trucks cannot follow.

Systems or agents do not need to react to every novelty. Some of them are just nuisance and do not affect the operations. Some novelties are transient and disappear and do not reappear. Some novelties are easy to detect and react to. Some novelties overlap with past novelties and system can easily adapt.

The context, timing, duration, extent, and duration of novelty must be considered in agent's adaption and accommodation. How to build AI/ML system that can adapt to fluid novelties in open world will be presented. We present scientific principles to quantify and characterize novelty in open-world domains. We identify measures and evaluation criterion for behavior of AI system when encountering novelties.

Novelties are found in many environments and agents must learn about them and accommodate them.

Video Link: <https://youtu.be/XWq8I-rv94U>

Short Biography: Bharat K. Bhargava is a Professor of the Department of Computer Science with a courtesy appointment in the School of Electrical & Computer Engineering at Purdue University. His recent research is on Intelligent Autonomous Systems and data analytics and machine learning. It includes cognitive autonomy, reflexivity, deep learning and knowledge discovery. His earlier work on Waxed Prune with MIT and NGC built a prototype for privacy preserving data dissemination in cross-domains. Currently he is leading the NGC REALM consortium. He has graduated the largest number of Ph.D. students in CS department at Purdue and is active in supporting/mentoring minority students. In 2003, he was inducted in the Purdue's Book of Great Teachers. In 2017, he received the Helen Schleman Gold Medallion Award for supporting women at Purdue and Focus award for advancing technology for differently abled students.

c. **Title:** Leveraging Artificial Intelligence and Machine Learning in Pandemics using COVID-19 as a Case Study

Speaker: Sven Groppe (University of Lübeck, Germany)

Abstract: The COVID-19 pandemic slows down or even often stopped the world's activities in economy, education, society, and other areas of our daily life, but was a huge trigger for research. Smart and hardworking scientists all over the world are still extending the knowledge about the COVID-19 virus and are contributing to various technologies to fight against the COVID-19 pandemic. Continuously newly occurring mutations of the original virus demand for still working on and improving the developed technologies against the pandemic.

This talk covers a short introduction into the effects of the COVID-19 pandemic by naming its winners and losers. Losers of the COVID-19 pandemic include infected humans (suffering more than necessary from overburdened health systems), economy (caused by lockdowns), students (having to catch up with missed topics due to closed schools), and society (suffering from canceled events). There are also some winners of the COVID-19 pandemic like vaccine developers (with increasing stock price performance), sellers of medical products (increasing their sales), and technologies used to overcome pandemics (the development of which is enormously triggered by funded research).

This talk tries to provide an overview to answer where computers can help in our fight against the pandemic. Many areas and technologies have been identified for this purpose. According to my opinion, the most important technology for a short-time reaction to the COVID-19 virus in medical research is sequencing a genome and analyzing it via supercomputers. One of the most prominent examples for other developed approaches are the predictions of incidence rates and other COVID-19 data (like hospitalization rates) considering COVID-19 confinements and other contexts by computer simulations and machine learning approaches. There is also a need for the management of physical contacts, e.g., at events and restaurants, and apps for personal contact tracking to warn a group of or single persons in the case they have been in contact with an infected person. In order to overcome security risks different approaches for contact tracking have been discussed and developed like mobile operator, location-based, and proximity-based contact tracing. Software within health systems has been improved or introduced, e.g., patient registration and status in hospitals, automatically recognizing COVID-19 patients from their computer tomography scans, and publicly available databases of confirmed COVID-19 cases and other COVID-19-related data, which are the basis for deeper analysis of the COVID-19 pandemic. On the basis of the achieved knowledge about the COVID-19 virus and the effects of the COVID-19 pandemic, a set of COVID-19 knowledge graphs have been released, which provide automatic means for answering related questions and help to structure the information flood of COVID-19-related data. Because of the enormous list of developed and used technologies related to COVID-19, this talk cannot dive into all of them, but will tackle the most important ones to learn for future pandemics.

Video Link: <https://youtu.be/GAnC0ktlJFU>

Short Biography: Sven Groppe is Professor at the University of Lübeck, Germany. He was a member of the DAWG W3C Working Group, which developed SPARQL. He was the project leader of the DFG project LUPOSDATE and two research projects on FPGA acceleration of relational and Semantic Web databases, and is a member of the Hardware Accelerator Research Program by Intel. He is currently the project leader of German Research Foundation projects on GPU accelerated database indices and on Semantic Internet of Things. Furthermore, he is leading a project about quantum computer accelerated database optimizations and he is project partner in a project about COVID-19 high-quality knowledge graphs, visualizations and analysis of the pandemic with 2 French partners. His research interests include Internet of Things, Semantic Web, query and rule processing and optimization, Big Data, Cloud Computing, peer-to-peer (P2P) networks, data visualization and analysis, and visual query languages.

He is the workshop organizer and chair of the Semantic Big Data workshop series (2016 to 2020) in conjunction with ACM SIGMOD. In 2021 and 2022 he organized the International Workshop on Big Data in Emergent Distributed Environments (BiDEDE) @ SIGMOD and the International Workshop of Internet-of-Things (VLIoT) in conjunction with VLDB since 2017. He is the general chair of the International Semantic Intelligence Conferences in 2021 and 2022.

d. **Title:** Responsible AI for National Security

Speaker: Amanda Muller (Artificial Intelligence Systems Engineer and Technical Fellow Northrop Grumman Mission Systems)

Abstract: Human-machine teaming is a critical consideration for ensuring the successful implementation of semantic technologies. Without consideration for the human element of an Artificial Intelligence or Machine-Learning-enabled system, performance will suffer, or worse—the system simply will not be used. AI ethical frameworks can be leveraged as an enabler of human-machine teaming by certifying that systems are developed in line with human values. Ethical frameworks such as the U.S. Department of Defense’s Five Ethical Principles of AI contain the necessary guidelines to ensure that AI systems are interpretable, governable, and usable by humans. However, there is no one-size-fits-all ethical framework—the right framework must be carefully selected based on the use case in question, the risk profile, and applicable laws and regulations. This presentation will examine the use of ethical frameworks as an enabler of human-machine teaming in AI, and the factors to consider when choosing the right one for a particular use case.

Video Link: <https://youtu.be/PKPhCtG3EDo>

Short Biography: Dr. Amanda Muller is a Consulting Artificial Intelligence (AI) Systems Engineer and Technical Fellow Emeritus based in Northern Virginia. Dr. Muller currently serves as the Responsible AI Lead for Northrop Grumman. In this role, she is responsible for coordinating the strategy, policy, and governance

efforts related to Artificial Intelligence across the Northrop Grumman enterprise. As a Mission Systems Technical Fellow Emeritus specializing in User Experience and Human-Systems Integration, she also serves as a subject matter expert on proposals, program reviews, and research efforts. Prior to her current role, Dr. Muller worked for Northrop Grumman Space Systems in Redondo Beach, California, as a Systems Engineer. She led the User Experience teams for several restricted space programs, conducting user research in operational environments around the world. Previously, Dr. Muller served as a Systems Engineer on State Health and Human Services programs, as a Human Factors Engineer in Aurora, Colorado, and as the Human-Systems Integration lead for airborne platforms in Melbourne, Florida. In addition to her program roles, Dr. Muller has been a mentor in the Mentoring the Technical Professional program for over seven years.

Dr. Muller's publications include a book chapter in *Emerging Trends in Systems Engineering Leadership: Practical Research from Women Leaders* (in press), and peer-reviewed articles in *Information Fusion*, *Journal of Defense Modeling and Simulation*, *WSEAS Transactions on Advances in Engineering Education*, and the *Annals of Biomedical Engineering*.

Dr. Muller holds a Ph.D. in Engineering from Wright State University in Dayton, Ohio, and B.S. and M.S. degrees in Biomedical Engineering from Worcester Polytechnic Institute in Worcester, Massachusetts. She also holds a graduate certificate in Design Thinking for Strategic Innovation from Stanford University. Dr. Muller is a Certified Systems Engineering Professional (INCOSE), Professional Scrum Master (Scrum.org), and is certified in Professional Scrum with User Experience (Scrum.org).

e. **Title:** Semantic Intelligence: The Next Step in AI

Speaker: Sarika Jain (National Institute of Technology Kurukshetra, India)

Abstract: Intelligent agents work autonomously by seeking necessary information, coordinating with each other, and taking necessary actions to make life simple for human beings. There are three information aspects for an intelligent agent: syntax (sentence construction, grammatical correctness), semantics (human-level interaction), and pragmatics (intention behind the communication). An intelligent agent is required to fuse heterogeneous sources of information together for which it should be equipped with both the data-driven (statistical) and knowledge-driven (symbolic) AI disciplines. We need a representation of our data that not only includes the data itself but where the interactions in it is a first-class citizen.

We have seen in the past decade that statistical models have revolutionized the world. Though the Statistical models have already proved themselves, they are not a Universal Solvent but only a tool as others. Deep learning is very good at learning in a static world and executing low-level patterns, provided it is fed with a lot of data. More deep, more intelligent, and, of course, more black. The question is "Is the AI of today Artificial Super Intelligence (ASI)/Artificial General Intelligence (AGI)/Artificial Narrow Intelligence (ANI)? Is the AI of today the AI that we are craving for?" In fact, today's artificial intelligence is weak AI. There are a number of

instances where DL has produced delusional and unrealistic results. Accuracy alone is not sufficient. We require exploring ways of opening the black box of statistical models. When DL researchers are asked to open the black box, this today implies less intelligent models to them (limited capability). In addition to increased performance, AGI aims to build trust.

Symbolic AI and statistical AI have to go together to achieve contextual computing. The symbolist approach is nowadays manifested as a knowledge graph that advanced statistics and machine learning can run on top of. The Hybrid Model combines machine intelligence with human intelligence to reach conclusions faster than possible by humans alone along with the explanations needed for trust in the decisions and results, while requiring far fewer data samples for training and conversing in natural language. The Hybrid Model is able to generalize and is excellent at perceiving, learning, and reasoning with minimal supervision. In addition, semantics have come a long way in enhancing explainability in AI systems.

Video Link: <https://youtu.be/r18vXwkt57Y>

Short Biography: Sarika Jain graduated from Jawaharlal Nehru University (India) in 2001. Her doctorate, awarded in 2011, is in the field of knowledge representation in Artificial Intelligence. She has served in the field of education for over 19 years and is currently in service at the National Institute of Technology Kurukshetra (Institute of National Importance), India.

Dr. Jain's major research interests include Artificial Intelligence, the Semantic Web, Ontological Engineering, and Knowledge Graphs. She has received grants from Defense Research and Development Organization, Department of Science and Technology, Council of Scientific and Industrial Research for research, and National Institute of Technology Kurukshetra for research projects; from All India Council for Technical Education (thrice) for FDPs; from DAAD RISE worldwide (thrice) for hosting research interns from Germany; and Ministry of Human Resource and Development (twice) for hosting a reputed international faculty and for FDP. She has published over one hundred peer-reviewed technical papers in books, journals, and conference proceedings. She has served as a General Chair, Workshop Chair, Program Committee Chair at many international conferences and workshops; and Reviewer for journals published by IEEE, Elsevier, and Springer.

She has held various administrative positions at the department and institute levels in her career. Among the awards and honors, she has received are the Best Paper Awards, Feb 2021 (two), Aug 2020, Aug 2017; and the Best Faculty Award, Sep 2019. Dr. Jain works in collaboration with various researchers across the globe, including in Germany, Australia, Malaysia, the United States, and Romania. She is a senior member of the IEEE, a member of ACM, and a Life Member of CSI.

Pre-conference Tutorials

ISIC 2022 witnessed three pre-conference tutorials under the umbrella of Semantic Intelligence. This series of tutorials was the fifth workshop on Semantic Intelligence in its series with the first four already held on different occasions. This workshop aims to establish the importance of using semantic data models by integrating the full potential of existing approaches, tools, techniques, methodology to provide situation awareness, and advisory support in a seamless manner among the participants.

Key features: The uniqueness of this workshop lies in several respects.

- This is the fifth workshop in its series and being well organized it discusses current research in knowledge-based systems and presents it in a way that non-experts in computer science may grasp.
- It provides comprehensive hands-on pedagogy in the latest approaches for developing and publishing Linked Data Applications on the web.
- This workshop will assist graduate and undergraduate students taking courses in Artificial Intelligence, Semantic Web, Knowledge Engineering, and Decision Support Systems.
- A novice in the field of computer science can learn how to use semantic web technologies for real-world challenges after taking this program.
- This workshop will be beneficial to a variety of users:
 - senior undergraduate and graduate students,
 - academicians and researchers, and
 - practitioners in all application domains.

1. Tutorial 1: Building Domain-Specific Linked Data Applications

Presenters: Sarika Jain, National Institute of Technology Kurukshetra, India; Pooja Harde, National Institute of Technology Kurukshetra, India; Ankush Bhist, University of Delhi, India; Nandana Mihindukulasooriya, MIT-IBM Watson AI Lab, Cambridge, USA

Duration: 3 Hours

Video Link:

Module 1—Semantic Web Vision as Motivation for Linked Data: <https://youtu.be/X9Y6snFFdUs>

Module 2—Hands-On Session for Knowledge Modelling: <https://youtu.be/vpOADh4qh5E>

Modules 3&4—Hand-On Sessions for RDF Creation and SPARQL Query: <https://youtu.be/8M5Xd9haF8k>

Description of the Tutorial: Traditional data techniques and platforms do not prove to be efficient because of issues concerning responsiveness, flexibility, performance, uncertainty, heterogeneity, scalability, accuracy, and more. This data is understandable by humans and is really not amenable for machine processing. Semantic Web and Linked Data technologies have been found as the most important ingredient in building artificially intelligent knowledge-based systems.

2. Tutorial 2: Knowledge Infused Reinforcement Learning for Social Good Applications

Presenters: Manas Gaur, Research Scientist, Artificial Intelligence Institute, University of South Carolina; Kaushik Roy, Ph.D. Student at Artificial Intelligence Institute, University of South Carolina

Duration: 2 Hours

Video Link: <https://youtu.be/A5SzrWBDxCY>

Description of the Tutorial: Reinforcement Learning (RL) is a popular framework to control a sequential decision-making process using rewards or reinforcement. Though optimizing a goal-directed reward is suitable for many real-world applications, the emergence of big data has led to highly data-driven and black-box algorithms. However, in social good applications, well-defined domain knowledge and procedural information are critical to human decision-making that should be incorporated in the reward. Furthermore, the significant discrepancy between black-box decision-making and human-like decision-making limits effective communication to facilitate the seamless incorporation of data-driven and human-provided rewards. In this study, we develop extit {Knowledge Infused Reinforcement Learning} (KiRL) that addresses the above challenges. We test our approach on benchmark datasets and real-world applications—specifically for Contagion Control and Mental Health Triaging. We illustrate the qualitative and quantitative efficiency of transparent, explainable methods that provide knowledge-guided, safe, and transparent mechanisms for effective interaction between human domain experts, users, and RL algorithms. Thus, this tutorial will establish the usefulness of KiRL as a much-needed technological assistance tool for real-world social good applications.

3. Tutorial 3: Knowledge Base Question Answering

Presenters: Nandana Mihindukulasooriya, MIT-IBM Watson AI Lab, Cambridge, USA

Duration: 1 Hour

Video Link: <https://youtu.be/2BknPDxaGUE>

Description of the Tutorial: Knowledge Base Question Answering (KBQA) is the task of providing precise answers to natural language questions using facts in a knowledge base and it has been an important research topic since the early days of AI. KBQA systems have been using many different approaches from rule-based expert systems to end-to-end deep-learning-based systems and more recently Neuro-Symbolic approaches. KBQA also has several closely related subtasks such as entity linking, relation linking, and answer-type prediction. In this talk, we will discuss the KBQA task, its challenges, different reasoning types needed for question answering, and different subtasks involved in KBQA. We will also look at different benchmarks for evaluating the KBQA task.

The Best Paper Awards

Like last year, this year also the International Semantic Intelligence Conference witnessed high-quality submissions. The conference committee selected three best paper awards this year after following a rigorous criteria. The selection was done at three levels with filtering being done at every level. The Track PC Chairs looked into the grading and the comments provided by the session chairs for every paper. The review comments received during the review process were considered for the second level of filtration. The Track PC Chairs themselves did the third level of filtration. The final major criteria set was the works pertaining to the theme of the conference, i.e., SEMANTIC INTELLIGENCE.

1. **Session Chairs (Presentations made):**

- Valentina Janev, Institut Mihajlo Pupin, Serbia;
- Archana Patel, Eastern International University, Vietnam;
- Fatmana Şentürk, Pamukkale University, Turkey;
- Sachi Nandan Mohanty, ICFAI Foundation for Higher Education, Hyderabad, India;
- Asha Subramanian, Semantic Web India, Bengaluru;
- Prakash Gopalakrishnan, Amrita Vishwavidyapeetham, Bengaluru;
- Filbert H. Juwono, Curtin University, Malaysia; and
- Kapil Gupta, National Institute of Technology Kurukshetra, India.

2. **Reviewers Comments.** The Technical Program Committee (TPC) is already announced on the ISIC 2022 website. The Program Committee is very diversified across the globe and the maximum percentage is the Artificial Intelligence researchers.

3. **Track PC Chairs (Overall):** The Track PC Chairs are already announced on the ISIC 2022 website. All the three Track PC Chairs are active researchers in Semantic Intelligence.

Professor Bharat K. Bhargava, one of the advisory committee members, announced the Best Paper Awards during the Valedictory session. Here is the list of papers that received the Best Paper Award during ISIC 2022:

Sr. no.	Paper title	Authors
1	Knowledge-based Extraction of Cause-Effect Relations from Biomedical Text	Sachin Pawar, Ravina More, Girish Palshikar, Pushpak Bhattacharyya, and Vasudeva Varma
2	Towards a Solution for an Energy Knowledge Graph	Dušan Popadić, Enrique Iglesias, Ahmad Sakor, Valentina Janev, and Maria-Esther Vidal
3	NyOn: A Multilingual Modular Legal Ontology for Representing Court Judgments	Sarika Jain, Pooja Harde, and Nandana Mihindukulasooriya

Contents

The Research Track

Toward a Solution for an Energy Knowledge Graph	3
Dušan Popadić, Enrique Iglesias, Ahmad Sakor, Valentina Janev, and Maria-Esther Vidal	
Web-Based Visualization and Analysis Framework for Graph Data	13
Fatmana Şentürk, Mehmet Ali Bilici, Sezercan Tanışman, and Vecdi Aytaç	
Web Service Credibility Evaluation Methods in Different Application Domains	29
Atef Shalan, Jaciel E. Reyes, Hayden Wimmer, Sarika Jain, and Mohamed Hefny	
Semantic Web Ontology for Botnet Classification	43
Omotola Adekanmbi, Hayden Wimmer, and Atef Shalan	
Design and Performance Evaluation of a Multi-patient Health Monitoring System	55
Samson Olasunkanmi Adigun, Ayodeji Olalekan Salau, and Fatima Chiamaka Ujunwa	
Discovering Novelty via Transfer Learning	67
Shafkat Islam and Bharat K. Bhargava	
An Ontology for Social Media Data Analysis	77
Sarika Jain, Sumit Dalal, and Mayank Dave	
The Coronavirus Disease Ontology (CovidO)	89
Sumit Sharma and Sarika Jain	
An Ethnolinguistic Research Agenda for Intelligent Autonomous Systems	105
Bharat K. Bhargava, Sarika Jain, and Abhisek Sharma	

QuantumRNG, A Random Number Generator Using One Qubit 119
Dara Ekanth, Bheemanathy Saketh Chandra, and Meena Belwal

Sign Language Detection Using Machine Learning 135
P. Ilanchezhian, I. Amit Kumar Singh, M. Balaji, A. Manoj Kumar,
and S. Muhamad Yaseen

**Scrutinize and Discover of Image of Freshwater Taken by Faraway
Realizing Using FFNN and ConvNet Mechanisms** 145
D. Komalavalli, P. Ilanchezhian, A. Diwakar, K. Gayathri,
T. S. Indhuja, and R. V. Devadharshini

**Knowledge-based Extraction of Cause–Effect Relations
from Biomedical Text** 157
Sachin Pawar, Ravina More, Girish K. Palshikar,
Pushpak Bhattacharyya, and Vasudeva Varma

**NyOn: A Multilingual Modular Legal Ontology for Representing
Court Judgements** 175
Sarika Jain, Pooja Harde, and Nandana Mihindukulasooriya

The Applications and Deployment Track

**Technologies for AI-Driven Fashion Social Networking Service
with E-Commerce** 187
Jinseok Seol, Seongjae Kim, Sungchan Park, Holim Lim,
Hyunsoo Na, Eunyoung Park, Dohee Jung, Soyoun Park,
Kangwoo Lee, and Sang-goo Lee

**Deep Learning-Based Classification of Customer Communications
of a German Utility Company** 205
Jinghua Groppe, René Schlichting, Sven Groppe, and Ralf Möller

The Trends and Perspectives Track

Short Analysis of the Impact of COVID-19 Ontologies 225
Sven Groppe, Sanju Tiwari, Hanieh Khorashadizadeh,
Jinghua Groppe, Tobias Groth, Farah Benamara, and Soror Sahri

**Demystifying Semantic Intelligence for Enabling Intelligent
Applications** 241
Sarika Jain

**Sentiment Analysis of Public Health Concerns of Tokyo 2020
Olympics Using LSTM** 255
Ayodeji Olalekan Salau, Temiloluwa Oluwatomisin Omojola,
and Wasii Adeyemi Oke